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Semi-Annual Technical Report:

The Development and Application of an Advanced Computer-Based Shared-Graphic Workstation for Video Teleconferencing

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Command and Control requires making complex and/or emergency decisions in various situations. Video teleconferencing has been developed to meet this need. Achieved by using a video based microprocessor, it encompasses a multi-node, low bandwidth five node configuration. Virtual space and shared data are the concepts behind this configuration. These developments led to the simulation of a traditional conference setting by adding shared information to the multi-node teleconference. Shared Graphics Workspace is the resulting effort enabling users to exchange and edit data with little or no training.

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SUMMARY

This Semi-Annual Technical Report covers the period from October 1, 1982 to March 31, 1983. The tasks, objectives and/or purpose of the project are concerned with the design, development, demonstration and transfer of advanced computer-based command and control(C2) with special emphasis on video-teleconferencing and graphics. This report summarizes work in the area of video-based microprocessor systems. Emphasis is placed on the development and experimentation of these systems. The system encompasses a multi-node, low-bandwidth design which includes a virtual space, shared data five-node configuration. A major portion of the discussion outlines the technical achievements required to make the system simulate as closely as possible a traditional conferencing setting. Engineering/hardware and computing/software discussions are focused on making the system useable for a conference. The idea is to enhance discussion and problem solving through the fast and accurate presentation of various forms of information. A discussion of future enhancements concludes this report.

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1.0 INTRODUCTION

This Semi-Annual Technical Report covers the continuing work on the design, development, demonstration and transfer of advanced computer-based command and control (C2) and video teleconferencing. Previous technical reports cover the research, prototype development and installation of many of the components of the video-teleconferencing system. This report, therefore, is focused primarily on the novel idea of the Shared Graphic Workspace System (SGWS). Conceived by Defense Department officials and designed and produced by Computer Systems Management (CSM) personnel, SGWS enhances the teleconferencing system by encouranging actual work, not just discussion. The work is done by sharing information (text, maps, data) and by having the capacity to make corrections on the shared information.

The main body of this report discusses the technological achievements required to achieve this goal of information sharing. To fully understand those achievements some of the requirements of the undertaking will be discussed. Following this will be a brief survey on some of the work that preceded the current effort. After the main body of the report, proposed enhancements will be briefly outlined.

1.1 THE RESEARCH TASK

The engineering achievement, the software development and the general accomplishment discussed in this technical report are all based on one seemingly simple but extremely important idea: to enhance information sharing among individuals. Adding complexity to the idea and challenge to the task is that the information shared among individuals is spoken, "non verbal", illustrated and textual. And finally, the information sharing is placed in a teleconferencing setting. The individuals may be scattered in a building, throughout a city, across the country or around the world.

The telecommunications task is to connect the individuals located in different and often distant offices. The information sharing component must, obviously, work with the telecommunications network. The various pieces comprising the information sharing technology were designed and then tested individually. These combined pieces were only one node of the communications network. Once the single node worked, it had to function on the telecommunications network. It is this telecommunications network of information sharing components that is the Shared Graphic Workspace (SGWS).

1.2 INFORMATION SHARING

The term "information sharing" is used for the conferencing situation, rather than communication, because communication tends to suggest only that which is spoken or expressed behaviorally in the conference setting. By information sharing we mean not only verbal and behavioral exchanges among the participants, but also textual, graphical, video and numerical exchanges. All of these attributes (verbal, non-verbal, textual, graphical, video and numerical) of information sharing are subject to the same process in the conferencing situation, however.

Very simply, the information sharing process follows this general pattern: the information is presented; its reception is acknowledged; evaluation of the information begins; changes, corrections or eliminations are made; termination of the sharing is achieved. While this brief list appears straightforward, it presents considerable technical difficulties. These difficulties may be illustrated best by posing two questions. How can written reports be displayed to the conferencing participants scattered around the world? And, more importantly, how can changes, corrections, illustrations, deletions or additions be made on these items by any one of the participants and visualized by all of them? It is the ability to change, correct or modify information that is the heart of sharing, not just the presentation of information.

1.3 INFORMATION SHARING REQUIREMENTS

One of the major requirements established at the beginning of the teleconferencing project was that the conferencing had to work during times of national emergency or crisis. It was the Defense Department's desire to have a communications network that would be operating during these episodes of chaos and uncertainty. These requirements meant that all communications, audio and video, had to take place over extremely low bandwidths (like those needed by telephones). Engineering and computing tasks followed this requirement.

Another requirement was that the conferencing situation had to be as natural or normal in operation as a standard meeting. This meant all participants in the conference had to be represented individually and that their automated representations or surrogates had to function more or less like individuals. The idea behind this requirement was that in times of emergency, the teleconferencing should be as familiar as possible to the participants. The teleconference, in other words, would be an island of normalcy in a turbulent sea. Needless to say, engineering and computing efforts followed these guidelines.

Although the current work has followed these guidelines, emphasis now is on the information sharing component of the teleconference. Two particular requirements determined the direction taken by both the engineering and computing efforts. Not unknown in the computing industry the two requirements, which are closely related, are that the information sharing must work in "real time" and "real motion".

"Real time," as is well-known, is simply that the computing system must work at the same speed or in the same time span as the actions of its users. For example, if a user is editing text with a stylus on a touch-screen, the computing must operate in the same time as the stylus---crossing out a word, inserting another and circling another. Similar to this and extending the example, is that the motion of the stylus as it crosses out, inserts or circles must also be replicated by the computer as the stylus is moved by the user. Real time represents the precise speed of a graphics movement and real motion represents the precise accuracy of the movement. Finally, real motion must work in real time.

2.0 PREVIOUS RESEARCH

The current teleconferencing network has as its antecedents the work completed under the titles of Virtual Space and Shared Data. The evolution from these ideas to the current network is similar to most undertakings: ideas are adjusted and refined as the work progresses; and technical achievements proceed by experimentation and experience. A brief review of the previous technical effort is necessary to trace the evolution of the current work.

2.1 VIRTUAL SPACE

Virtual space technology was designed to follow one of the requirements stated previously; namely, that teleconferencing should simulate as closely as possible the structure and process of a real meeting. Each individual should be able to interact with others as they would in a meeting. When one person is talking, the others face that person. When another person speaks, attention is shifted to that speaker. But each listener, if they look at other listeners, will see that the others are also facing the speaker and maintaining "eye contact" with the speaker.

Those familiar with video-conferencing will immediately recognize the novelty to the virtual space approach. Most video-conferencing systems do not permit this simulation of meetings. Indeed, most available video-conferencing systems show only groups of people to one another and miss altogether the nuances of intra-group interaction.

To achieve this effect of virtual space, rooms were designed for one person. Facing the desk in each room are four columns, each containing a TV monitor that displays a different individual, a camera and a loudspeaker. The first stage in virtual space was a four-station system with the video linked by ordinary coaxial cable, hardwired between each of the stations. The current system has five stations and is represented in Figure 1.

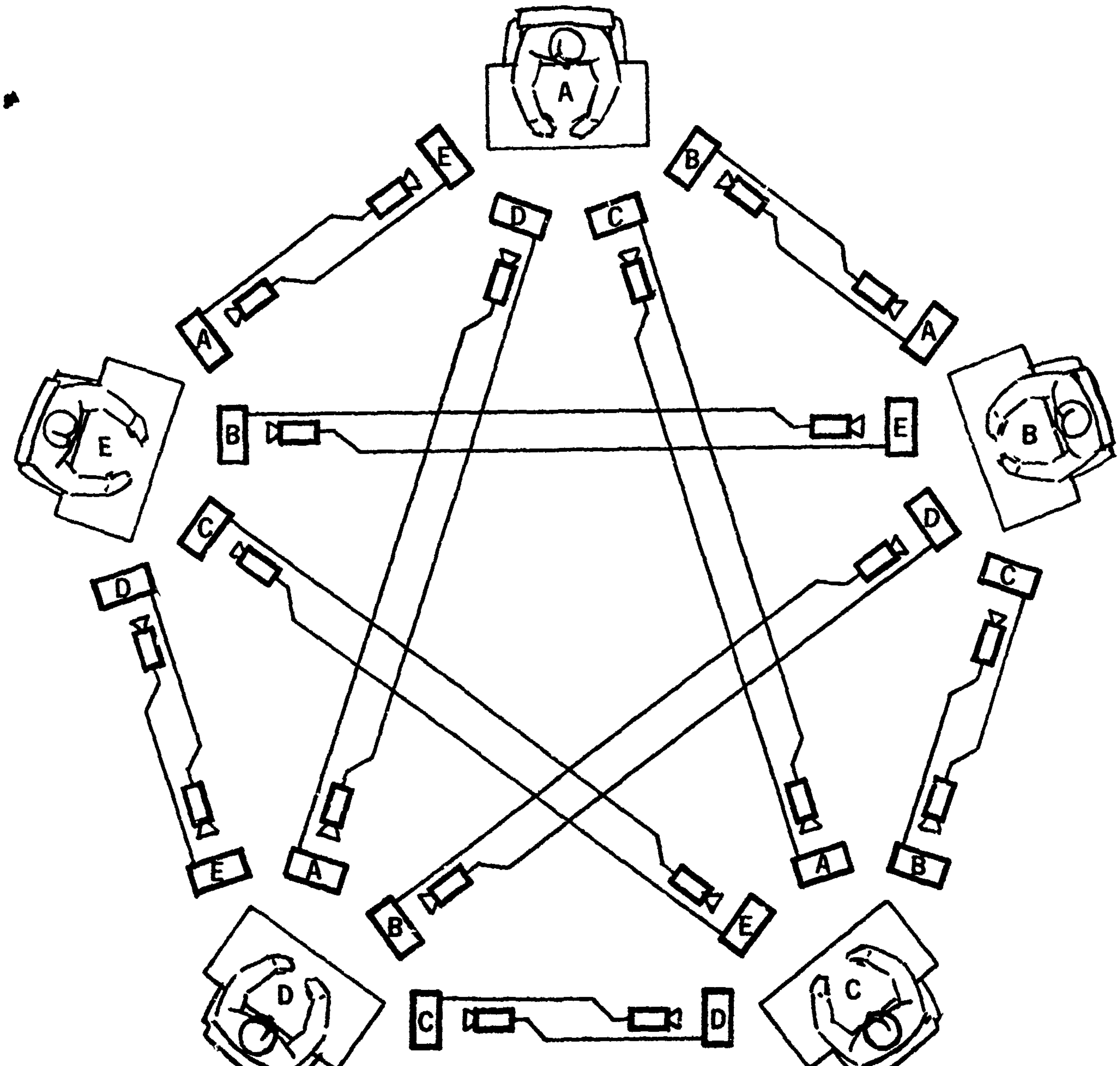


FIGURE 1

VIRTUAL SPACE
TELECONFERENCING
NETWORK

The physical design and appearance of the virtual space videoconferencing system differs substantially from conventional systems. Instead of placing all monitors (one for each station of the network), on a wall, the virtual space design isolates each monitor in its own column or cabinet. In conjunction with the camera and loudspeaker, the columns become the "conferee surrogate". Another advantage of this approach, in addition to the visual perspective just mentioned, is that audio is localized to the individual columns. This permits each conferee to hear the voice of the individual who is talking, and associate the location of the audio with the location of the video.

A major task of the system was to present to each conferee the nonverbal communications of the others. Since most nonverbal communications are presented by facial expressions, cameras were mounted in a permanent position focusing on the face of the conferee. While this meant that camera operators were not required, the significance of this effort (to represent the facial expressions of the conferees), was the transmission of the facial image over a very small bandwidth: 19.2 kilobits per second or about 1/4700th of the full bandwidth.

To compress the information content of the image to such a small (and incidentally a much, much lower cost) bandwidth required the use of one of the new codecs (coder-decoders). The codecs in the system are built by Compression Labs, Inc. and use two dimensional run-length encoding to reorganize the information in the signal.

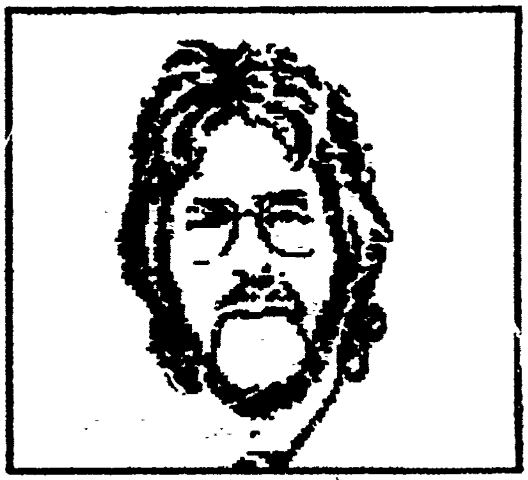
The result of this information manipulation is an image that corresponds to a pencil "sketch" of the individual. The "sketch" also "lives" as long as the actions of the individual are not too sudden or dramatic. To capture the individuals' actions, the transmission rate of frames is approximately seven to ten frames a second. And the display quality is high; the image is stored digitally and refreshed at a rate of about 60 frames per second. Figure 2 offers a comparison of a "sketch" and a photograph.

The audio portion of virtual space has two components. One component permits verbal communication from each individual to all other conferees. This "global" component consists of a shot-gun mike placed in an unobtrusive position and the signals are transmitted over standard leased lines. The second component permits private conversation between any two of the conferees. This "local" component consists of an ordinary telephone and autodialer wired with a cutoff switch to the shotgun mike so that all "local" conversations are private. Obviously, this component permits private conversation, that, in a traditional conference setting would be confined to the disruptive practice of subdued secondary conversing.

After numerous demonstrations and constant evaluation, it is clear that the strength of the virtual space aspect of the teleconferencing project is its remarkably small bandwidth. Recall that the bandwidth is only 19.2 kilobits per second (kbps). This means that even when four simultaneous images are transmitted out of the room, the total required bandwidth is less

A

SOURCE IMAGE



B

DECODED IMAGE

FIGURE 2

COMPARISON OF SOURCE IMAGE AND DECODED IMAGE than 150 kpbs. And this includes telephone quality audio that is also compressed to 16 kbps. Because a small bandwidth means substantially less cost, the bandwidth alone makes this system very appealing; but when the small bandwidth is combined with the audio and video components of virtual space---and all this is added to the capability of sharing data---this teleconferencing system becomes truly exciting.

2.2 SHARED DATA

Shared data, the second key element of the teleconferencing system, evolved through experimentation and experience. The original telegraphics system, called Telepad, consisted of five Apple computers communicating with one another in a ring network. The system provided a menu of options, including five "ink" color selections, selections of a common graphics database and utility functions such as "clear screen."

Telepad cost little, but was effective. It proved to be adequate only when the subject matter did not require a large volumn of information to be passed among the users, however. Five colors could be displayed on a 280 x 192 pixel display screen. While adequate to display very simple charts, graphs and text, the system was not able to display documents or video. Finally, the menu displayed to the user was displayed on the video monitor. While convenient, the menu, needless to say, occupied a portion of the limited display area.

After Telepad, an initial Shared Graphic Workspace System (SGWS) designed for a low-node full-bandwidth virtual space system was developed. Each node contained a black and white TV monitor, a black and white overhead camera, an optical video disc player and a computer terminal. Data were shared in this technology by placing material under the camera. Conferees could point at items in the material or write on it and these efforts were displayed to all the conferees. But this early version did not have storage and retrieval capabilities, high resolution or a color capability. Nevertheless, this first SGWS was easy to use and indicated the potential of this particular distributed computer graphics system.

In the next stage of development, the SGWS five-node low-bandwidth teleconferencing system was designed as an all digital color system to be operated jointly by the conferee and an assistant. Staff support is common in conferences; not only did this continue to simulate a traditional conference, but the assistant was the person responsible for searching for data. Also, the SGWS configuration consisted of a RGB monitor with a touch-screen and a digitizing tablet. Other equipment in the configuration included a videodisc player, data source interfaces, video switches and amplifiers, a sync-generation, a frame buffer, a DEC PDP 11/23 computer and the codecs. Figure 3 displays the configuration.

This is the current SGWS configuration. While the basic design of the five-node low-bandwidth teleconferencing has been completed, certain corrections and adjustments have been made. The discussion now turns to these corrections and adjustments.

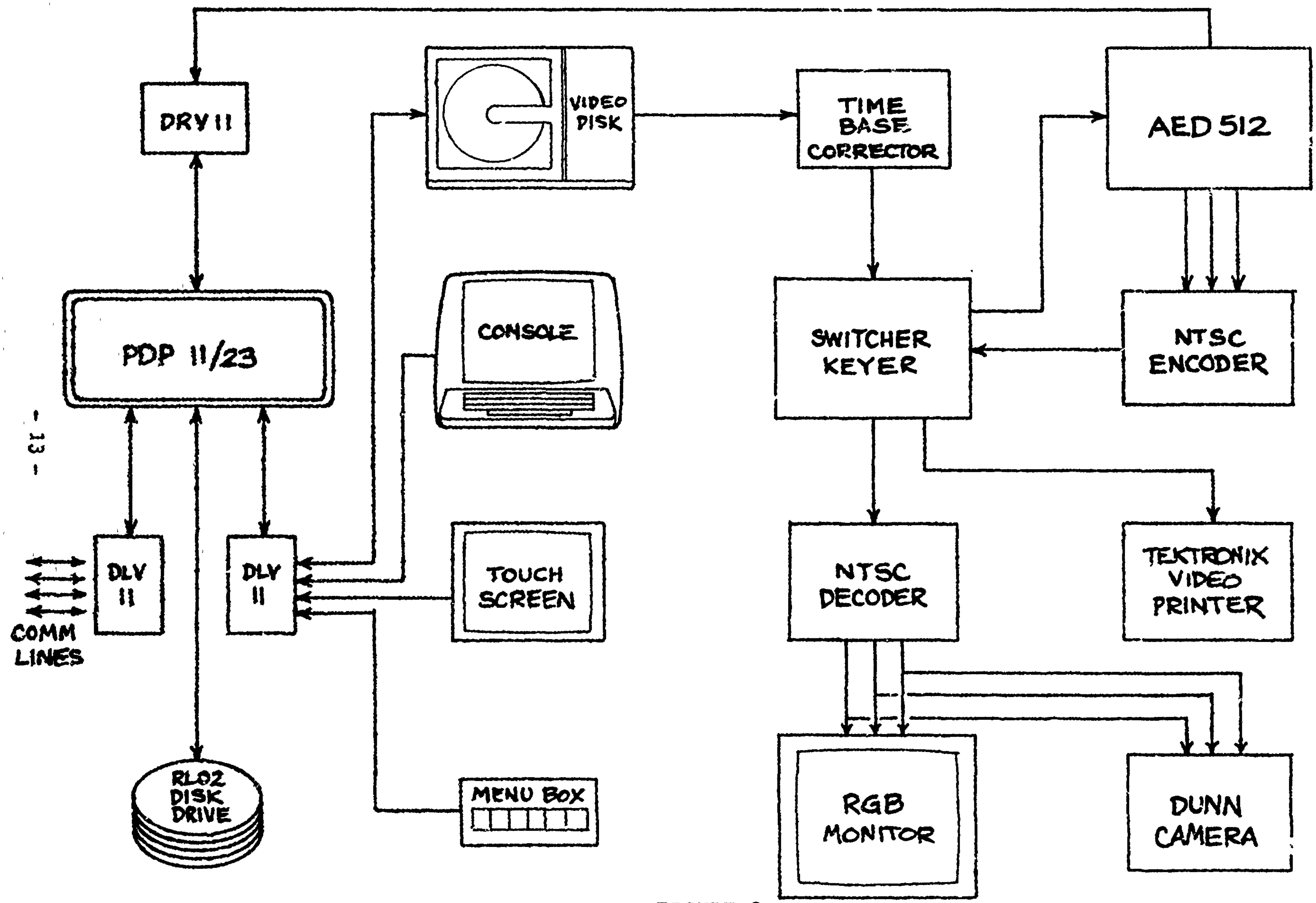


FIGURE 3

SYSTEM CONFIGURATION

3.0 CURRENT EFFORTS

The current work on the teleconferencing project in general and the SGWS component in particular was driven by engineering/hardware and computing/software considerations. Both of these considerations have to complement the other: the engineering developments would not work to their full potential without computing; and the computing accomplishments would be merely "interesting" without the engineering component. While the work on the engineering/hardware and the computing/software progressed simultaneously, for clarity each will be discussed separately. But first is a brief summary of some changes and adjustments made on the entire system.

A major adjustment during the current effort was changing the SGWS from an all digital system to a digital/analog system. This was done primarily to obtain high quality color images of maps. Maps, charts and other graphic information were stored on an optical disc. These different pieces of graphical information are "underlays" that could be brought up on a monitor with a touch-screen. The monitor with the touch-screen was mounted horizontally on a mobil pedestal. Also, a stylus was designed for "writing" on the touch-screen. This combination of monitor and stylus was designed to replicate pencil and paper. And finally menu boxes permitted the user to select the color of "ink" flowing from the stylus and choose other commands for information manipulation.

3.1 ENGINEERING AND HARDWARE

The brief summary touches on the major engineering accomplishments: menu boxes were built; touch-screen controllers were modified; and a mercury switch stylus was assembled. Most engineering work was dedicated to interfacing the input controls and the output functions. For example, pushing the button for the color red on the menu box and then moving the stylus across the touch-screen are input protocols that had to be transformed into graphical output functions. The color of ink (red) and the stylus motion by one conferee at one station in the network is replicated on the monitors of all the other conferees on the network. And recall that this entire sequence (stylus on touch-screen, input controls and output function) works in real time and real motion.

3.1.1 Menu Boxes

The menu boxes are exactly what their name state: long, narrow boxes with eight buttons for different selections from the SGWS menu. A menu box is displayed in Figure 4. Five of the buttons are colors (white, red, yellow, green or blue) of the "ink" that flows from the "pen" onto the monitor page. Because there are five colors and five stations on the network, each conferee can make annotations on the monitor page and the identity of the annotations will not be confusing (as long as two conferees do not use the same color). This is how the SGWS encourages work: underlays or other information are placed on the monitors and the conferees make their corrections in their color

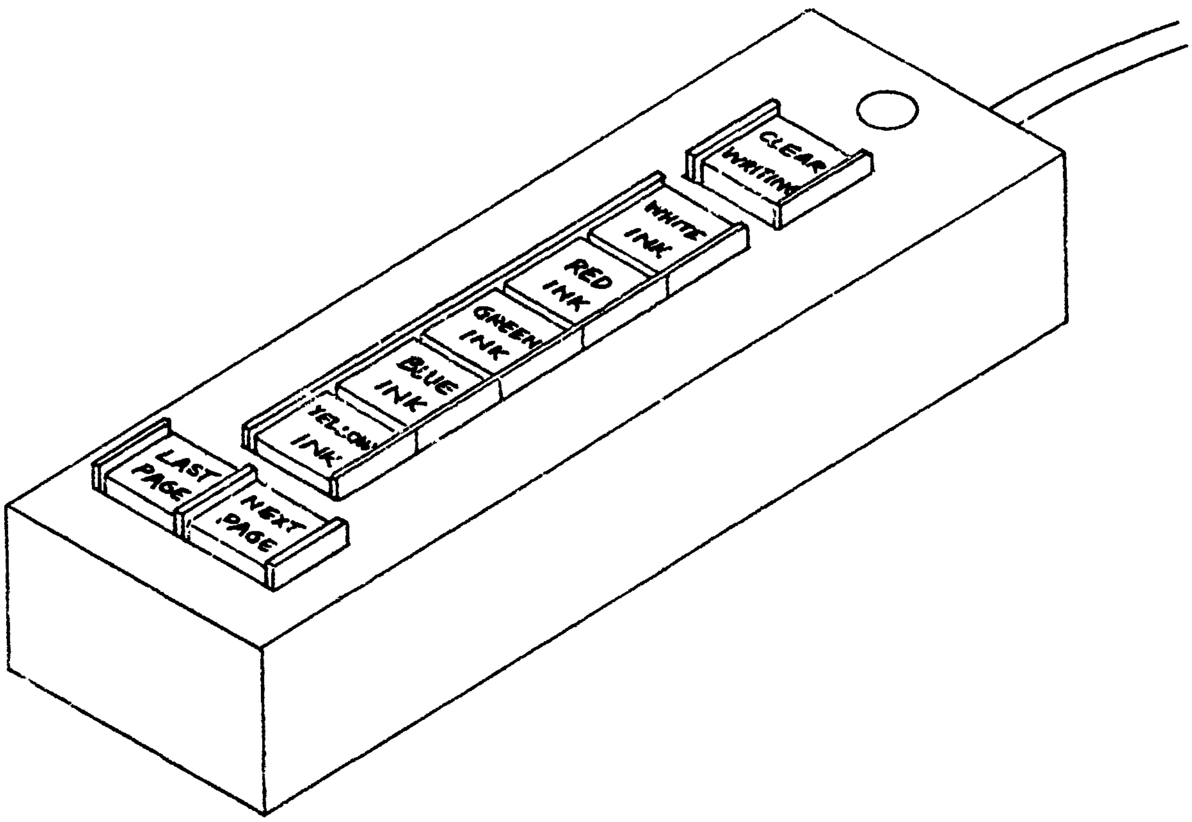


FIGURE 4

MENU BOX

via the touch-screen and stylus.

Another capability of the SGWS is also on the menu box controls. In addition to the five color buttons are three buttons that control the writing function. At the bottom of the box are the buttons "next page" and "last page". These two buttons permit the conferee to view a page and then move on to the next page or review the previous page. In addition, the conferee can write on the page and the entire page (original information and conferee writing) will be saved. The "next page" button will automatically save the first page and move to the next. Similarly, if the conferee stops using the SGWS on page three, but wants to review previous work at some time in the future, it is necessary only to press the "last page" button to retrieve pages one and two. Those pages, with all their annotations, will be displayed on the monitor. To avoid confusion concerning which page is being viewed, a page number is constantly displayed for reference in the upper right hand corner of the monitor.

The best way to think of the SGWS is as a 20 page electronic reusable or easy-to-edit notebook. The notebook is easy to edit for the reasons just mentioned and it is reusable because of the "clear writing" button. Located at the top of the menu box, the clear writing button will erase all writing on the page. The page itself will remain intact---only the annotations of the conferees will be removed. The SGWS has a second erase capability but that will be discussed shortly.

It is important to emphasize that the pages which are saved or edited using the menu box are computer files. The SGWS also uses a videodisc player. This allows any video image to be displayed or annotated on the monitor, but any annotations will be saved in computer files. Currently the SGWS uses a videodisc containing 34,000 frames of information. Each one of the frames can be displayed. It is also possible, using a computer terminal connected to the SGWS, to type in a name of a place and have a map of that area appear on the monitor. For example, a conferee could type in "El Salvador" and a map of El Salvador would appear on the monitor.

The major capability of the menu box is the editing function. It can move through 20 pages of information stored in computer files and it permits the annotation of these 20 pages (and the annotations can be saved) or the annotation of the information stored on the frames of the videodisc. It is a seemingly simple component of the SGWS possessing powerful capabilities.

3.1.2 Touch-Screen Controllers

Most of the work involving the touch-screen controllers will be explained during the computing/software discussion. For now it is important to know that minor engineering adjustments were made in the touch-screen to enhance the speed and accuracy of any movement on the screen. Computing plays the major role in meeting the demands of real time and real motion on the touch-screen.

3.1.3 Mercury Switch Stylus

To complete the emulation of traditional writing (the horizontal monitor and touch-screen are the surface or "paper" of writing), an electronic stylus was designed and constructed to be used as a pen or pencil. Originally built with a connecting wire, users objected to this as unnatural so a wireless stylus was developed. Very simply, the stylus is a wooden pen containing a crystal-controlled transmitter. The transmitter permits the user to write or erase on the touch screen. Figure 5 contains the design of the stylus.

When the stylus is in the "write" mode the transmitter is off. Thus, when the stylus is placed on the touch-screen, writing will appear on the monitor. But when the stylus is in "erase" mode the transmitter is operational. As soon as the stylus is turned over, just like a pencil, the mercury switch in the stylus turns on the FM transmitter. This in turn activates a frequency modulator, which sends a signal to the FM receiver.

The FM receiver feeds the detected signal into a tone-decoder to verify the accuracy of the signal. If the signal is accurate, the signal is forwarded to the computer as an on/off switch. The computer verifies that the transmitter is on, and instructs the graphics component to initiate the erase mode, or to follow the motion of the eraser over the touch-screen and eliminate whatever inscriptions are under the eraser.

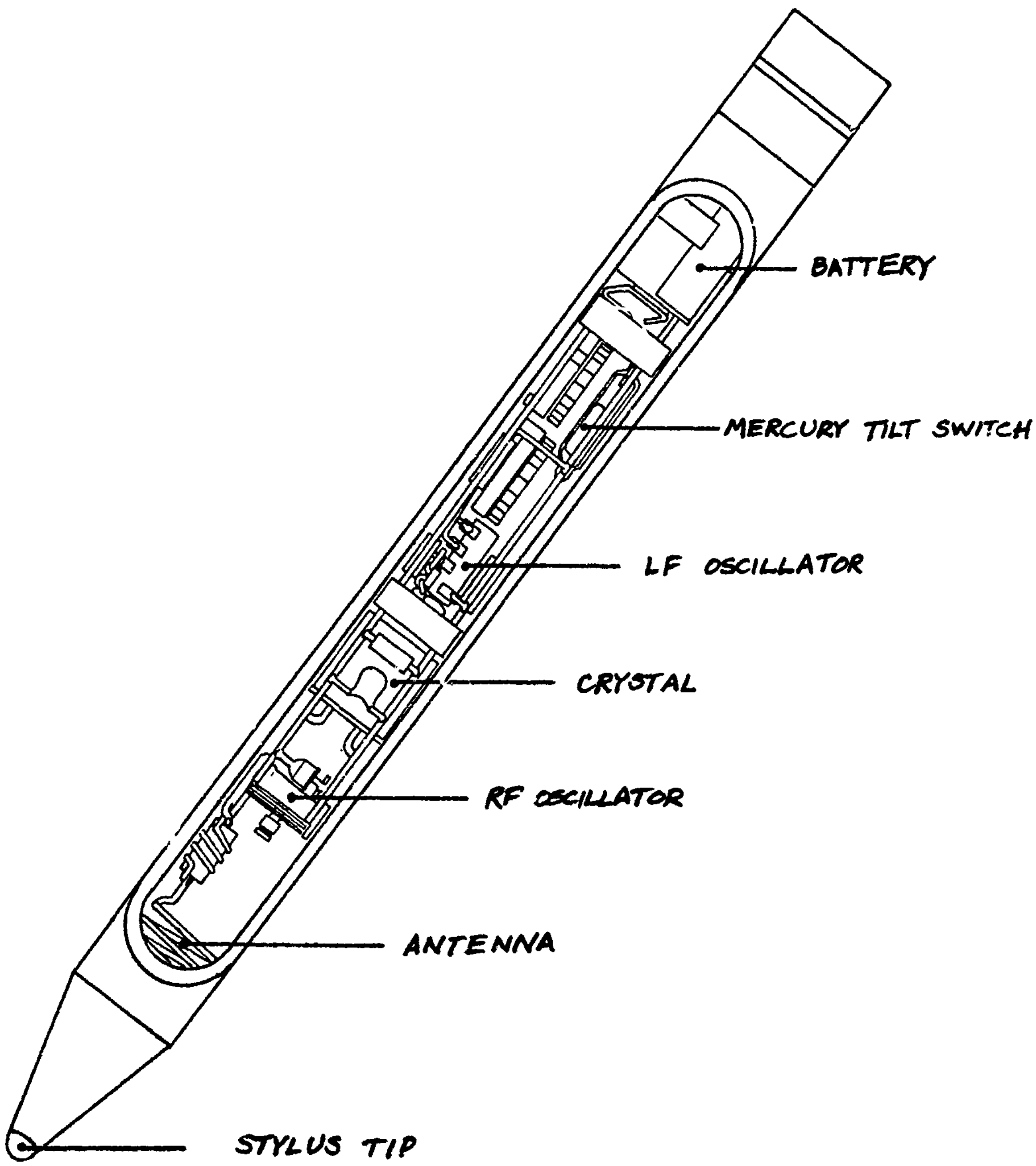


FIGURE 5

MERCURY SWITCH STYLUS

The mercury switch stylus is a complex on/off switch. Nevertheless, its physical appearance and electronic function are designed to make it familiar, and therefore usable, to those prospective conferees who may not be accustomed to working in such an automated environment. The stylus, like the touch-screens, menu boxes, and all the other machinery (videotouch players, monitors, codecs, and computers) must work accurately and quickly with all the other components. Computing and software coordinate the various components and make them work in real time and real motion.

3.2 COMPUTING AND SOFTWARE

Computing and software development for the Shared Graphics Workspace (SGWS) is divided into the application of the software to each graphics node and the networking or linking together of the five nodes. Each of the nodes has to work: the input/output functions; the save and store or next-page/last-page; and the capability of displaying various types of information from the computer files or videodisc. All of this has to function individually on each node. Then all the nodes have to work quickly and accurately on a low bandwidth, and therefore lower speed, network.

3.2.1 Applications

Two major achievements permit the fast and accurate operation of an individual graphics node. This first achievement, made possible by advances in hardware techniques, is the modification of the UNIX operating system drivers for Direct Memory Access (DMA). DMAs are hardware techniques for moving information to or from memory from or to the input/output (I/O) device. Generally, information transfer of this type requires regulation by the central processor. This regulation slows down the movement of information between memory and the I/O device. The DMA technique requires the central processor only to initiate and terminate the process. While information is moving from memory to the I/O device, and back again, the central processor is available for other tasks.

For the application on the SGWS using a DEC PDP 11/23 computer, existing drivers (programs) incorporating DMA techniques had to be almost totally rewritten to accomodate the need for contiguous file handling and extremely fast I/O. At this time, the speed of the information transfer from memory to the I/O device is the maximum available. Hardware adjustments must be made to make the system run faster. The significance of this complex effort is that the user waits only one second, rather than five, for a new display on the monitor. Given the current hardware constraints, this is as close to real-time as possible.

Because the operations of the entire system are never observed by any one user, the significance of this achievement may be overlooked. Nevertheless, the user is the individual who starts the entire process, by requesting this system to display images or information and then waiting a few seconds to see the initial request. In the span of those seconds the DMA technique, as designed by CSM personnel, has the central processor along with memory and I/O devices working simultaneously to present to the user an accurate image which can be refreshed at a very high speed.

The second major achievement also pertains to speed and deals with the touch-screen controller mentioned earlier. The touch-screen controller is part of a graphics system. Many graphics systems are now obtaining real time capabilities through advances in hardware techniques such as DMA interfaces, dual-ported memory and dedicated graphics processors. Despite these advances a major problem remains. The various input devices (touch-screens, bit pads and joysticks) do not send data to the central processor in formats acceptable to the graphics processor. This means that all the manipulations necessary for the correct graphical representation must be executed each time the coordinate pairs of the representation are changed. This process adds considerable time to the graphics processor, thus diminishing its real time attributes.

The achievement, therefore, is the modification of the software for the touch-screen to eliminate the need for the formatting manipulations by performing the formatting within the controller. The software modification does not repeat redundant coordinates and only requires one to four bytes to be sent to the central processor for each coordinate pair. Vastly improved speed is the result of this modification. Prior to the modification, plotting speed was 80 coordinates per second. After the modification, the plotting speed increased from 160 to 500 coordinates per second---or an improvement of 100 to 500 percent.

An additional value of this modification is that the output of the formatting is Tektronix Plot 10 compatible. A great number of graphics processors use the Tektronix standard, making the software modification more readily transferable to other graphics processors.

3.2.2 Network

With the completion of the applications work for each node of the network, the task was to make the entire network function. The basic problem was to take the information coming in from any node of the network and then sending it out to all the other nodes of the network. Most of the work for the network had been completed during earlier phases of this project, so the current effort was allocated to simply making sure the network operated correctly. Several caveats are in order, however.

First is that the network is low-speed. While this appears initially to be a disadvantage, the network is highly configurable and will work anywhere where there are telephones. This means that the entire network can work with computers and modems with auto-dialing capabilities. Second, the current network has been tested using five nodes, but it will function with a total of eight nodes. And finally, the typical configuration is a local-area network or a network that is "hard wired" together. Advantages of the local-area network is that it by-passes modems with auto-dialers and can be used in the same building or in offices of close proximity. But this typical system is not as configuable as the wide area low-bandwidth network.

3.3 ADDITIONAL INFORMATION AND ENHANCEMENTS

Closing out this section on current efforts are some minor but nevertheless interesting accomplishments. One is that it is possible to place information on the network from a word processor. Since many offices use word processors, being able to move information from the processor to the network is convenient and saves duplicating effort. Another is that electronic information stored on other networks, such as The Source or Telnet, may be loaded onto the network. Virtually any type of electronic information that can be accessed by telephone or easily transferred can be shared by the users on the network.

Two other enhancements were placed on the current network. One is that all text was white on a black background. This was changed to black text on an amber background. The other was that when the videodisc was moving between pages, the monitors would flicker while waiting for the change. The enhancement of this was to place a blank "page" between the video disc images, thus eliminating the flicker. Both of these enhancements were designed to make viewing much easier and more pleasant for the user.

4.0 FUTURE ENHANCEMENTS

A major characteristic of research and development work is that it continues: new ideas emerge from the experience; refinements are made as insight accumulates; and enhancements extend the utility of the product. The Shared Graphics Workspace and its low-bandwidth network are not immune from this trait of technological innovation and production. The enhancements to be discussed briefly continue the effort and hopefully will make the entire telecommunications system even more useful.

One of the future enhancements is to increase the storage space on the re-usable notebook (the computing file) from 20 to 132 pages. The benefit of this enhancement is obvious: larger or several different documents can be placed in the system. Another enhancement designed to make the system more efficient is to automate the back-up procedure of the information on the system. Automation of this important computing procedure further reduces the chance of losing valuable information. Further aiding the user is the design and implementation of menus for briefing preparations. Clearly, this will help the user's organization. Mentioned briefly in the previous section, another enhancement is the installation of a remote access modem to make connection tc other networks (e.g., The Source or Telnet) easy and fast. While these connections are possible now, they are somewhat cumbersome.

Two final enhancements are worthy of special attention. The first enhancement is to place information stored on a written page onto the network. The significance of this enhancement is far reaching. Written pages will not have to be re-entered in a word processor and then transferred to a node on the network. Instead, traditional (printed on paper) pages or reports will simply be copied by a copy machine. The resulting copy, instead of coming out of the copy machine, will be placed on the network. This enhancement should aid the transition from traditional offices and conferencing to electronic paperless offices and conferencing.

The final, for the time being, enhancement is a voice store and forward capability. This enhancement is analagous to a tape cassette. The speaker can make a presentation for the network, store it, and then forward it to all the other conferees. The listening conferees are then able to receive the speaker's presentation at their leisure. This is another enhancement that personalizes communication among individuals who are scattered across the country or around the world and separated by time zones.

5.0 CONCLUSION

The main intent of this report has been to outline the technical achievments of, primarily, the Shared Graphics Workspace (SGWS). Recall that the major requirement of the SGWS was that it resemble as closely as possible traditional work tools such as pen and paper. This requirement meant that all engineering and computing capabilities had to work in real time and real motion. Given existing hardware and software constraints, the engineering and computing efforts met the goal of working in real time and motion. In this sense, therefore, the technological work on the SGWS must be termed successful. But the success of this work extends beyond the technological achievement.

The real success of these technological achievements is the close adherence to the true purpose of a conference. Information is shared, work is done, and decisions can be made---just as in a traditional conference. The technology permits face-to-face contact, verbal and non-verbal communications and the presentation of text and graphics. The structure and process of a conference are represented by the concept of virtual space, and the function of a conference (to exchange and correct information) is made possible by the Shared Graphics Workspace.

It is no small accomplishment to replicate via state-of-the-art technology human interaction and behavior. It is an even greater accomplishment to use technology to promote human interaction. The real value of this technology, therefore, is its capability for promoting the work necessary for the completion of group tasks and decisions.

6.0 REFERENCES

Argyle, M., and Cook, M. Gaze and Mutual Gaze New York: Cambridge University Press. 1976

Brody, Herb "Reach Out and See Someone." High Technology 3 (August 1983): 53-59.

Brown, E.F.; Limb, J.O.; and Prasada, B. "Continuous Presence Video Conferencing System." Birmingham, Alabama: Conference Record, 1978 IEEE Telecommunications Conference. pp. 34.1.1-34.1.4, December 1978.

Chapanis, A.; Ochsman, R.B.; Parrish, R.N.; and Weeks, G.D. "Studies in Interactive Communication: I. The Effects of Four Communication Modes on the Behavior of Teams During Cooperative Problem-Solving." Human Factors 14 (December 1972): 487-509.

de Bono, Edward, "New Think," The Hearst Corporation, 1967.

Johansen, R., Vallee, J., and Spanger, K. "Electronic Meetings: Utopian Dreams and Complex Realities." The Futurist 12 (5): 313-319.

Kelly, Clinton W. III. "An Enhanced Presence Video Teleconferencing System." Proceedings from the Fall 1982 IEEE COMPCON Conference: 544-551.

Morley, I.E., and Stephenson, G.M. "Formality in Experimental Negotiations: A Validation Study." British Journal of Psychology 61 (3) (1970): 383-384.

Sticha, P.; Hunter, G.; and Randall L. Research Into Teleconferencing Technical Report TR80-9-314, Decisions and Designs, Inc., McLean, VA., February 1981.

Ungaro, Colin. "Teleconferencing Focuses on a New Era", Data Communications pp. 85-97, September 1982.

Williams, E. "Coalition Formation Over Telecommunications Media." European Journal of Social Psychology 5 (4) (1975a): 503-507.

Wittmeyer, James F. III., Olson, K.A. and Heath, T.M. "The Development and Application of Advanced Video and Microcomputer-Based Command and Control (C2) Systems." Technical Report 82-02, Computer Systems Management, Inc., Arlington, VA., December 1982.